Space Weather Technical Forecast

Issued on Tuesday 4 March 2025 at 01:21 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance of G1/G2 late Day 1 into Day 2. Chance of active 24-hour electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 has been Low, with a peak flare of C2.8 at 03/1647UTC from the largest sunspot region on the visible disc presently located in the southeast quadrant.

The solar disc features eight sunspot regions. Two of the regions have seen some increase in complexity in the past UTC day. Most notably being AR4007, which is the second largest region on the disc and has seen some penumbral growth, spreading and consolidation, along with a temporary small Mt Wilson delta spot in its trailing region. AR4012 in the southeast has also seen some development and is the largest region on the disc, with recent emergence of several new spots. AR4009 appears relatively stable with some consolidation in the trailing spots. AR4006 and AR4011 are relatively small and simple spots on the disc, with little recent change.

No Earth-directed Coronal Mass Ejections (CMEs) were identified in available coronagraph imagery in the period.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, are indicative of a continuing waning connection to a strong positive polarity coronal hole fast wind (CH19/+).

Solar winds have been on a declining trend, waning from elevated levels near 500km/s to end the 24 hours at Slightly Elevated levels near 480km/s. The solar wind density was at slight above average levels before becoming below average from 03/0300UTC onwards at less than 5ppcc. The IMF was at mostly Background levels with a peak of 9nT at 03/1146UTC, while the north-south component favoured a positive direction, rangING from +8/-5nT. The phi angle was largely positive (away from the Sun).

The net result of the above solar wind measures was Quiet geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

High energy electron flux saw a rise in its diurnal oscillation, reaching High levels of 1130pfu at 03/1635TC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), on a level trend, recording 4.71e7 integrated pfu at 03/2100TC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily Chance of reaching Moderate levels, given a Chance of isolated M-class flares. This may rise slightly over the next few days as regions potentially return over the eastern limb.

Solar Wind / Geomagnetic Activity: A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/1900UTC. This is the only CME in the forecast.

Otherwise, High Speed Stream (HSS) solar wind influence from CH19/+ is expected to continue to wane, with Slightly Elevated winds declining towards Background prior to any CME arrival. This is the only coronal hole in the forecast.

Geomagnetic activity is expected to be quiet (Kp 0-2) until late on Day 1 Tuesday 04 March, whereupon the aforementioned CME brings a chance of minor geomagnetic storm G1 to end the UTC day and on into Day 2 (5 March). Activity should lessen once again later in the UTC working week.

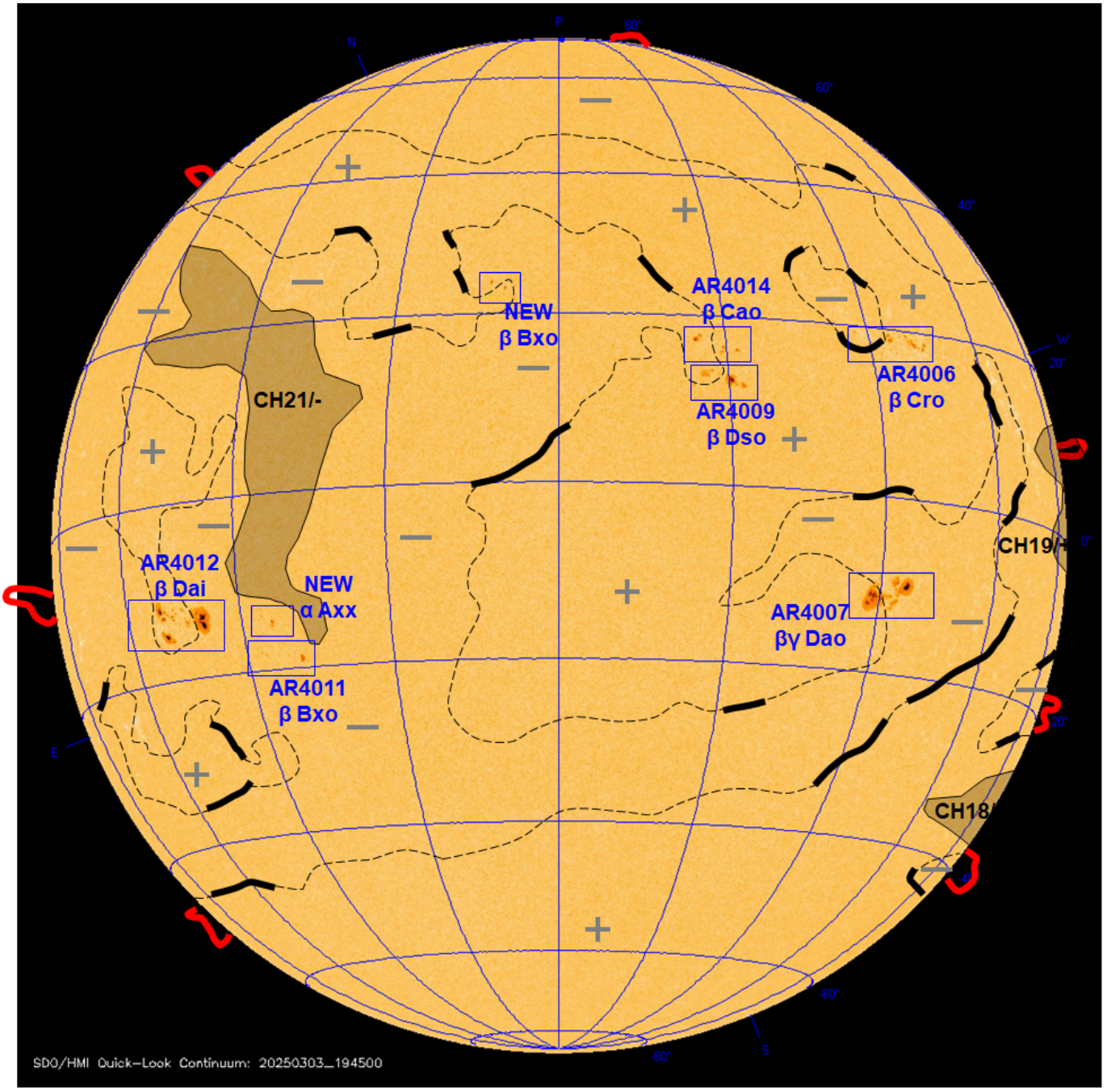
Energetic Particles / Solar Radiation: High energy proton flux should remain at Background levels.

High energy electron flux has seen diurnal rises into the high levels in the past 24 hours, which is might be repeated during Day 1 (4 March). Consequently the associated 24-hour fluence has the potential to continue to rise, with a decreasing chance of breaching the Active (1e8 integrated pfu) threshold during the guidance period. The 01/1730UTC CME reduces confidence from midweek UTC, with perhaps a Chance of Active fluence surviving should the CME miss or prove limited in effects.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 1: Solar synoptic map valid 03/2000UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Geomagnetic Storms

A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow later on Day 1 (4 March). It appears the majority of the ejecta is south and east of the Sun-Earth line, and is likely to miss Earth. This is the only CME in the forecast.

In addition to the above, the otherwise High Speed Stream (HSS) influence from CH19/+ is expected to continue to wane, with currently Slightly Elevated winds probably declining towards Background in the coming 24 hours or so. No further coronal holes are expected to feature in the forecast period.

Geomagnetic activity is Likely to be Quiet until later on Tuesday 04 March, whereupon the aforementioned CME brings a Chance of G1 (Kp5) to end the UTC day and on through midweek UTC. There is a Slight Chance this may reach G2 (Kp6) given the nature of the eruption, should it arrive early in the evening with unfavourable polarity. Because of the forecast arrival time coming late in the 24-hour UTC day, much of the G1 risk is actually post-dated into Wednesday 05 March in the magnetic cloud, although this may not fully develop due to the glancing incidence expected.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	40	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
02/0154UTC	Partial?	Filament eruption	SE quadrant	550	Late UTC day Tuesday 04 March, around 04/1900UTC.	Potentially protracted but marginal effects on passage given glancing incidence.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 2: Latest MOSWOC ENLIL showing CME influence from later on the 4 March.

© Crown Copyright 2025. All Rights Reserved.

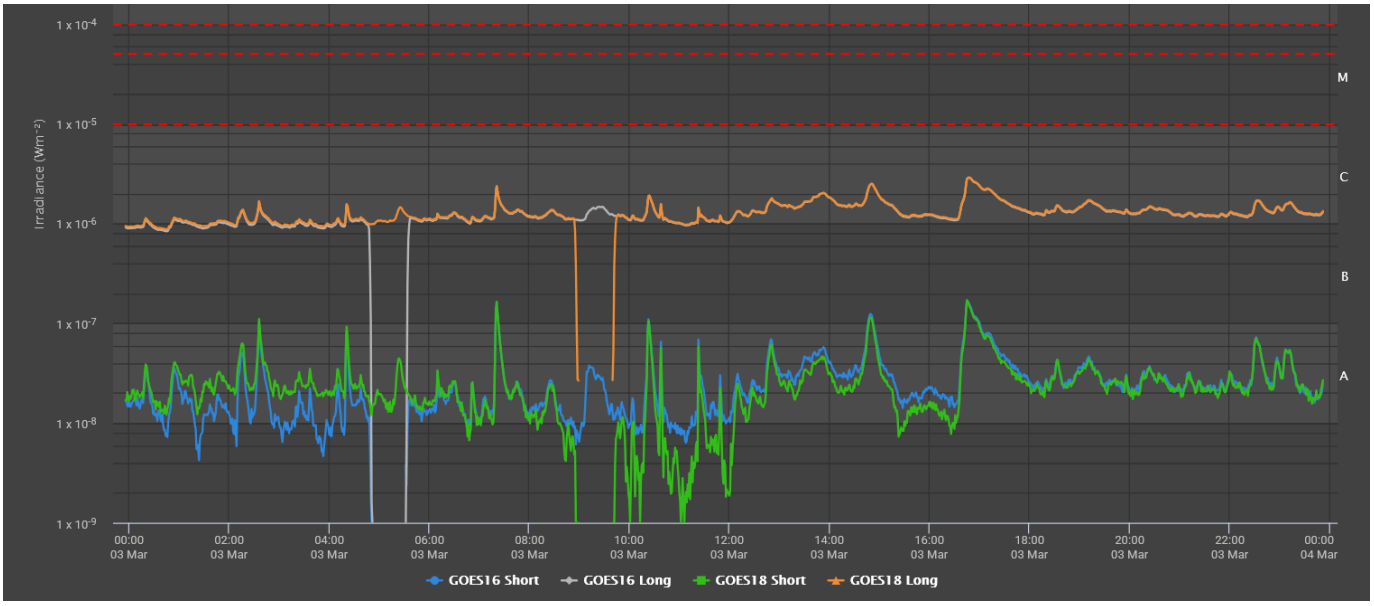
Radio Blackouts - X-Ray Flares

Eight sunspot regions cover the visible solar disc with two unnumbered regions. In terms of magnetic complexity the most notable is AR4007, in the southwest, which is now the second largest region on the disc but has recently lost a small Mt Wilson delta spot in its trailing region. AR4012 in the southeast is now the laregst region with further development displaying recent emergence of several new spots. AR4009 lies just south of AR4014 and both regions are bi-polar and have been relatively stable. AR4006 and AR4011 now represent the smallest and simplest spots on the disc, with little change.

Solar activity is Low, with occasional low level C-class flares. Solar activity carries an increasing Chance of M-class flares however, with up to three returning regions perhaps due over the eastern limb inside 24 hours' time.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	30	40	40	40
Very Active	R3-R5 (X Class)	No	1	1	1	1

Figure 3: GOES16/18 X-ray flux in past 24 hours.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

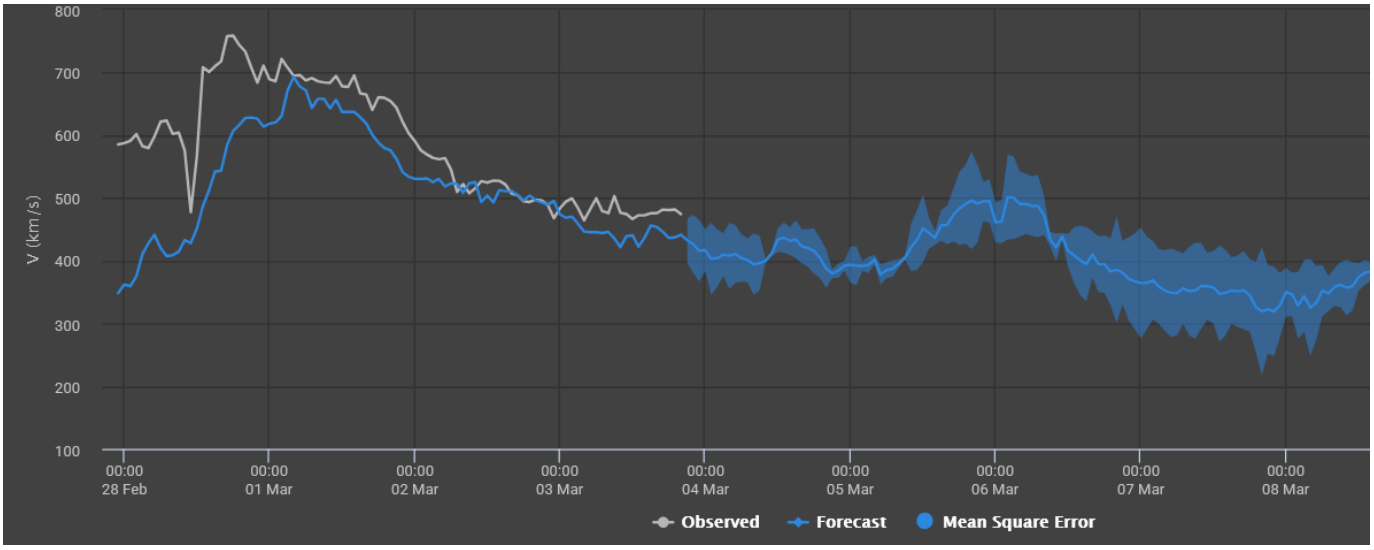
© Crown Copyright 2025. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is at Background, and expected to remain at this level. There is a Slight Chance of enhancement to S1 given any significant eruption from the sunspot regions currently on the Earth-facing disc, very gradually increasing through midweek UTC as some of the more complex regions reach better-connecting parts of the disc (i.e. the westernmost third).

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office Solar Winds prediction Model (SWPM) indicating decline in solar winds over coming days.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES16, has seen High flux for a short period in the past UTC day. This was due to the recent charging of the outer Van Allen Belt from the fast wind enhancement from CH18/+ and/or CH19/+. This might continue through Tuesday 04 March, in a reaction to the recent Strong solar wind. High flux being maintained at GEO becomes far less certain through midweek UTC as a result of possible influence of the 01/1730UTC filament CME, which may cause electron redistribution and falls of flux at GEO.

The associated 24-hour fluence is now flat-lining with a decreasing chance of rising above the Active level into Tuesday 04 March. Guidance as provided by REFM indicates Active fluence will probably not be reached in this guidance period. This is before any fluence trend is polluted by potential CME influence and confidence is overall reduced. The chances of Active fluence persisting through midweek then rely on any CME missing Earth, else a very gradual erosion of GEO electron counts might be expected in the coronal hole-free forecast period.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	40	40	30	30
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 5: Electron Flux plot from GOES at GEO and MOSWOC REFM showing electron fluence rise over recent days, along with forecast levels.

© Crown Copyright 2025. All Rights Reserved.